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Disciplinary and gender differences among higher education students in self-regulated learning strategies

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This study explores how university students representing diverse disciplines and gender differ in their self-regulation in learning. The definition of self-regulated learning (SRL) in the present study is based on Pintrich's and Zimmerman's theories of SRL and comprises motivational and learning strategies. The sample consisted of 1248 undergraduate students at several Finnish universities. The data were retrieved from the IQ Learn online self-assessment and tutoring system. Female students scored moderately higher than male students on help-seeking strategies, utility value and on performance anxiety. Among the diverse disciplines, minor mean differences emerged on all the sub-dimensions of SRL, though no clear regularity on any discipline's favour was perceived. However, male and female students of behavioural sciences and female students of sciences scored highest consistently, and the technology students, especially the male students, scored lowest. In the future, the relations between the students' self-regulation in learning and instructional approach should be studied further.

Keywords: self-regulation in learning; self-assessment; higher education; disciplinary differences; gender differences

Introduction

Self-regulation in learning

University students are generally assumed to possess metacognitive skills to self-regulate their learning. Furthermore, evidence suggests highly self-regulative learners are academically more successful than those students with low self-regulation skills or those who lack regulation in their learning (Heikkilä & Lonka, 2006; Lynch, 2006; Tynjälä, Salminen, Sutela, Nuutinen, & Pitkänen, 2005). It is assumed that students who can self-regulate their learning, if necessary, can also modify their learning strategies to accomplish different academic tasks (Zimmerman, 2000).

Self-regulated learning (SRL) is a complex phenomenon. Several theorists have attempted to define this multifaceted construct to identify the many variables of it (Pintrich, 2000; Zimmerman, 2000). Among these theorists' models, for example, are Biggs' (1978, 1985) model of metalearning, Zimmerman's (1989, 2000) social cognitive view of academic self-regulation, Winne and Hadwin's (1998) four-stage model of SRL, Vermunt and colleagues' (Vermunt, 1996; Vermunt & van Rijswijk, 1988)

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learning styles in which the regulation of learning is emphasised and Pintrich's (2000) general framework for SRL. During the last three decades, SRL has been explored extensively, and different constructs and conceptualisations have been presented (e.g. Boekaerts & Niemivirta, 2000; Butler & Winne, 1995; Corno, 1993; Pintrich & De Groot, 1990; Pintrich, Wolters, & Baxter, 2000; Pressley, 1986; Schunk, 1994; Winne, 1995; Zimmerman, 1986, 1989, 1998a, 1998b, 2000). All these models share some general assumptions and features which Pintrich (2000) has analysed to provide a synthetic overview and a general framework for the theory of SRL. As a condensed definition based on the assumptions of several models of SRL, Pintrich (2000) states the following:

> A general working definition of self-regulated learning is that it is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment. These self-regulatory activities can mediate the relationships between individuals and the context, and their overall achievement. (p. 453)

Pintrich (2000, 455) suggests that the four phases of self-regulation are: (a) forethought, planning and activation; (b) monitoring; (c) control; and (d) reaction and reflection. Pintrich also points out that not all academic learning follows these phases because there are many occasions for students to learn academic material in more tacit, implicit or unintentional ways, without self-regulating their learning. Pintrich also adds that the phases are not necessarily hierarchically or linearly structured, but monitoring, control and reaction can be ongoing simultaneously and dynamically. According to this position, a learner often changes and updates goals and plans while progressing through the task according to the feedback from monitoring, control and reaction processes. Zimmerman (2000) and Pintrich share the idea of the cyclical SRL, where SRL is influenced both by the self and the social and environmental context. According to Zimmerman's theory, SRL consists of three dynamic and intertwined phases: forethought, performance or volitional control and self-reflection. The phase of performance or volitional control is similar to the phases in Pintrich's theory: monitoring and control. Based on Pintrich's and Zimmerman's theories, we define SLR, from a social cognitive perspective, as a cyclical and dynamic process which is interdependent of social, environmental and self-influences (Zimmerman, 2000).

Interdisciplinary differences

There is evidence that the instructional methods and the focus of student learning differ remarkably in diverse disciplines (Neumann, Parry, & Becher, 2002; Smeby, 1996). Entwistle and Tait (1990) demonstrated that students prefer to study in disciplines which reflect their approach to learning. Heikkilä and Lonka (2006) provided evidence that SRL is related to students' approaches to learning. In their study, the students' deep approach, self-regulation of learning, and optimistic strategy clustered together, while problematic aspects of the students' learning, such as surface approach, external and lack of regulation, and self-handicapping, were also related to each other. Disciplines are generally divided into categories on the basis of cultural and epistemological differences, for example Biglan's (1973) *pure hard*, *pure soft*, *applied hard* and *applied soft* disciplines. According to Neumann et al. (2002), *pure* *hard* disciplines mainly involve instructional methods that are mass lectures and problem-based seminars. The focus of student learning is on fact retention and on the ability to solve logically structured problems. Student learning is commonly assessed by testing frequently, comprehensively and unequivocally. Knowledge is then hierarchically structured and learning is a cumulative process in which it is necessary to develop a good basic knowledge of the facts for understanding the concepts. In Vermunt and Verloop's (1999) terms, this expresses a strong teacher-regulation of learning, and the students' self-reflection and *self-assessment* are not the crucial elements for a deep understanding of the theories or subject. According to Neumann et al. (2002), *pure soft* teaching methods include both face-to-face class meetings and tutorial teaching consisting of discussions and debates. What are emphasised in student learning are creativity in thinking and fluency of expression. Here continuous assessment is preferred and grading may depend on the presentations in which the interaction between the students and the assessor is allowed. This teaching method enhances a student's awareness of his or her own thinking and learning processes. This kind of interplay may be interpreted as shared teacher regulation. Since the *applied hard* sciences are concerned with the mastery of the physical environment, teaching methods concentrate on simulations and on case studies in relation to professional settings. As in the *pure hard* sciences, students of the applied sciences are expected to learn facts, but in the *applied hard* sciences, more emphasis is placed on practical competencies and on the ability to apply theoretical ideas to professional contexts. Furthermore, in assessment, rigorous testing is used to eliminate the weaker students. Using Vermunt and Verloop's (1999) terminology, *applied hard* sciences may reflect a strong teacher-regulation of learning.

It is noteworthy that, in the *applied soft* sciences, the teaching methods are close to those of the *pure soft* sciences. Here the emphasis is on personal growth and intellectual breadth. As a consequence, the intention of the assessment procedures is to improve self-reflection and practical and professional skills. For the *pure soft* sciences, typical assessment methods are the essay- and project-based assessment as well as peer and self-assessment. Among the *applied soft* disciplines, the teacher-regulation of learning seems to be the loosest when compared to the other discipline categories mentioned above. Moreover, using self-reflection in assessment may suggest that students are encouraged to self-regulate their learning. The existence of different academic cultures in different disciplines has also been identified by Parry (1998) in a study on academic writing in different disciplines. The production of knowledge, as well as the means for communication, vary in different disciplines, and students learn tacitly the norms of their disciplinary culture (Parry, 1998; Ylijoki, 2000).

Vermunt and Verloop (1999) investigated the interplay between the student-regulation and teacher-regulation of learning. According to their theoretical model, the degrees of student-regulation (self-regulation) of learning differ from high to low, and the teacher-regulation of learning may be strong, shared or loose. In cases where the student's learning strategies and the teacher's teaching strategies are not compatible, friction occurs. Constructive frictions, which we may refer to as challenges, may be necessary to stimulate students to develop skills concerning their learning and thinking activities, which they are not inclined to use on their own. Instead, destructive frictions may cause a decrease in learning and thinking skills, for instance, when existing skills are not called upon or potential skills are not developed. In cases of destructive friction, problems in studying may also occur.

Vermunt and Verloop (1999) refer to the interplay between the student and the teacher as destructive friction in those cases where the student's degree of regulation is high or intermediate and the teacher-regulation of learning is strong, or the student's regulation is high and the teacher's regulation is shared. As for the opposite situation, where the student's self-regulation is low and the teacher's regulation loose, this type of interplay also causes destructive friction. For instance, teachers may expect high self-regulation from students and may, therefore, regulate loosely the learning situation, but students are incapable of self-regulation and would like to use an externally regulated strategy but do not receive directions for doing so.

The university is a social context for learning, and we assume that students entering the university will develop diverse SRL strategies due to the influence of the disciplinary teaching and learning culture they encounter. In this way, students can increase or decrease their self-assessment and self-reflection when receiving social feedback and when interpreting the social cues from instruction and interaction with their teachers and peers. If self-assessment is highly valued in the disciplinary field, students probably develop higher self-assessment and self-reflection skills than in the disciplines where self-assessment skills are less valued. However, studies on disciplinary differences are rare in the self-regulation of learning for higher education students. Hativa and Birenbaum (2000) conducted a research focusing on the preferred teaching approaches of education and engineering undergraduates. This study showed a significantly different preference with regard to the teachers' promotion of self-regulation, with education students outscoring engineering students. Hativa and Birenbaum also found that a student's high intrinsic goal orientation and low extrinsic goal orientation predicted the preference for instruction that promoted self-regulation. Furthermore, Niemi, Nevgi, and Virtanen (2003) reported statistically significant interdisciplinary mean differences on performance anxiety as measured by a self-assessment instrument which was based on the Motivated Strategies for Learning Questionnaire (MSLQ). Specifically, the students of teacher education, technology and science judged themselves to be less anxious than the students of humanities, behavioural sciences, and agriculture and forestry ($F[3, 239] = 3.38$, $p < .05$). In addition, the technology and science students used significantly less self-assessment in their learning than students of teacher education, humanities, sciences, and agriculture and forestry ($F[3, 239] = 3.37$, $p < .05$).

Gender differences

Pintrich and Zusho (2007) reviewed the research on the gender differences related to the motivational aspects and SRL. They concluded that the research on gender differences in motivational beliefs has proved to be inconclusive. However, they mention one possible exception: females generally tend to have lower self-perceptions of their academic ability in mathematics and science, even when their actual performance is not lower than that of the males (Eccles, 1983; Meece & Eccles, 1993). Perhaps the stereotypic idea that females are less capable in the above-mentioned disciplines reduces the female students' self-efficacy in these disciplines, as their concern about conforming to a gender-role stereotype is stronger than their actual genuine interest in these academic fields (Wigfield, Eccles, & Pintrich, 1996). Nevertheless, this concern of conforming to the stereotype of one's gender is typically strongest during adolescence (Wigfield, Eccles, & Pintrich, 1996). On the other hand, Pintrich and Zusho (2007) argue that the mean level differences in the self-efficacy between the genders may be a manifestation of response bias. In addition, females may have a tendency towards modesty when rating their confidence levels, while males may exaggerate their levels (e.g. Pajares & Graham, 1999).

Nevgi (2002) and Niemi et al. (2003) investigated the relationship of the higher education students' SRL strategies and their gender by using a self-assessment instrument adapted from the MSLQ. The MSLQ measures SRL as an aptitude, which is a relatively enduring attribute of a person that predicts future behaviour (Winne & Perry, 2000). In the context of Finnish higher education, research using the self-evaluation questionnaire modified from the MSLQ has revealed that, in general, the self-regulation in learning of students is on a moderate or higher level (Niemi et al., 2003), but the self-regulation skills of individuals vary from naïve to skilful on several sub-scales of the questionnaire (Virtanen & Nevgi, in preparation). Nevgi (2002) and Niemi et al. (2003) reported that females used keywords and advance organisers while studying more often than males, and females also connected new knowledge more actively to the knowledge acquired in the earlier stages of their studies. In addition, Niemi et al. (2003) discovered significantly higher intrinsic motivation among the female higher education students as compared to their male peers.

Bembenutty (2007, 2009a) has conducted a few studies on the gender preferences of higher education students and, specifically, on the academic delay of gratification (ADOG), which is defined (Bembenutty & Karabenick, 2004) as a student's postponement of the immediately available opportunities that would satisfy impulses in favour of pursuing important academic rewards or goals that are temporally remote but ostensibly more valuable. According to their study, ADOG was positively related to attributes such as *self-efficacy*, *intrinsic interest*, *metacognition*, *effort management*, *time management* and *help-seeking*, which all can be considered as being components of SRL. In addition, Bembenutty (2007) reported significant differences between the genders on the task value and the ADOG. In his later study, Bembenutty (2009a) provided evidence that the willingness of female students to delay gratification was influenced more than in the case of male students by the female students' perception that continuing studying may increase their chances of getting a good mark. Moreover, the use of stress-reduction strategies had a greater effect on females than males on their willingness to delay gratification.

There is evidence that females are underrepresented in disciplines such as science, engineering and mathematics, even though their abilities needed in these academic disciplines are not worse than males' (Rayman & Brett, 1995). For example, females in Finland made up to 57% of all new university students in 2007, but among the new students of technology and architecture, only 24% were females and among new students of education, only 19% were males (Statistics Finland, Education Statistics, 2008). Pajares and Valiante (2001) conclude in their research that some gender differences in academic motivation and SRL may be a function of gender stereotypic beliefs rather than the students' gender *per se*. If this is so, these beliefs seem to be decreasing, however, because the number of both female and male students studying in disciplines that are traditionally not typical to their gender is increasing every year. This suggests that strong self-regulated learners seem to be able to modify their learning strategies subject to the requirements of variable learning environments and settings. However, few studies report the self-regulation of students in atypical and typical disciplines for their gender. Niemi et al. (2003) found a statistically significant correlation among almost all the measured components of SRL and the higher education students' conceptions concerning how sure they were that they have chosen a discipline suitable for themselves and how satisfied they are with their major. Specifically, the students' conceptions correlated positively ($p < .001$) with their *expectations of success*, *intrinsic motivation*, *utility motivation*, *time management*, *self-management*, *persistency* and *self-assessment*. In contrast, this motivational attitude correlated negatively ($p < .001$) with *performance anxiety*, but a statistically significant correlation was not found between the students' conceptions and their *self-efficacy* or *help-seeking strategies*. Niemi et al. did not report correlations between conceptions and SRL within female and male students or in different disciplines.

Aims of the study

This study explores how self-regulation strategies differ in diverse disciplines by investigating four research questions. The first is how the components of self-regulation in learning are related to each other. Second, does the self-regulation in learning differ between female and male students? The third question is what salient characteristics of self-regulation in learning can be distinguished in diverse disciplines, and in what ways does this self-regulation in learning differ among disciplines. And finally, are there interdisciplinary differences in the self-regulation of learning that are connected to gender groups?

Based on the previous research (Bembenutty, 2007, 2009a, 2009b; Meece & Eccles, 1993; Niemi et al., 2003; Pintrich, 2000; Pintrich & Zusho, 2007), we assumed that several components of self-regulation are positively related to each other, but that *performance anxiety* is negatively related to the other components. Concerning gender differences, we presumed minor differences, but that female students might score lower on self-efficacy. We also expected that the students representing *hard* or *applied hard* disciplines may score lower in *self-assessment* and the students of the *soft* disciplines may have higher *performance anxiety*.

Method

The sample and data collection

The participants in this study were students who used the interactive online system of the IQ Learn during the years 2004–2008. Our assumption was that most of the students have used the IQ Learn system as a part of orientation to their studies' courses in diverse universities. This system has been presented to the teachers of higher education in the national training of the pedagogical practice of information and communication technologies. In addition, it is possible that some of the students have found the IQ Learn system independently and have used it for their own purposes.

A total of 5091 student responses to the IQ Learn questionnaires were retrieved during October 2008 from the data matrix saved by the IQ Learn system from April 2004 to October 2008. Owing to the missing data on one or more sub-scales, 1683 cases were excluded from the retrieved data.

The matrix saved by the system provided us with the students' electronic mail addresses and the date when a student had used the system. The electronic mail addresses mainly were in the form of 'first name.last name [at] institution.country code'. The participants' demographic variables, such as institution and gender, could be identified and coded from their email addresses. A total of 1996 participants were excluded from the sample, as it was not possible to identify the university from their email addresses. In addition, 164 participants were excluded because their discipline was not able to be determined from the electronic mail directories. Furthermore, the email addresses of 273 students were in such a form (using the short version of their name or as course identification numbers) that their genders could not be defined. Nevertheless, these data concerning them were included in the sample. As a consequence of these reasons for excluding participants, the final sample consisted of 1248 students.

The students were from eight Finnish universities representing six different disciplines: economic sciences (n = 425), technology and architecture (n = 376), the behavioural sciences (n = 153), biosciences and medicine (n = 114), science (n = 113), and the faculty of arts (n = 66). The sample consists of participants who were all very likely first-year students. As the sample is authentic, the participants' ages and the amount of courses completed may vary substantially, for in Finland, these characteristics of the first-year higher education students are very variable. For this reason, the sample represents well the Finnish first-year students in higher education.

IQ Learn – self-evaluation instrument

The participants of the present study used the online self-evaluation and tutoring system, the IQ Learn. This system was developed for students to become aware of their SRL and for teachers to support their students to develop SRL skills in online learning environments and in other higher education settings (Niemi, 2002a, 2002b). The three self-evaluation questionnaires in the IQ Learn instrument are modified from the MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1991, 1993). The questionnaires encompass Paul Pintrich's Motivational Components of Forethought, Cognitive Strategies, and Learning Skills (Pintrich, 1995, 1999, 2000; Pintrich & Garcia, 1991; Pintrich & Ruohotie, 2000). The validity of the IQ Learn self-evaluation questionnaires has been examined repeatedly. In the pilot study, Cronbach's alpha coefficients of the sub-scales varied from .42 to .78 (Niemi et al., 2003). Following the pilot study, the homogeneity of the sub-dimensions was improved by revising some items as suggested in the pilot study. In the revalidation phase, the alphas of the sub-dimensions varied from .63 to .83 (Nevgi, Virtanen, & Niemi, 2005).

In the present study, 10 sub-scales of the IQ Learn self-assessment instrument were applied. From the *Forethought of Learning* questionnaire, the following sub-scales were included: (1) *expectation of success* in learning (four items); (2) *performance anxiety* (four items); (3) *self-efficacy* beliefs of learning (four items); (4) *intrinsic interest* (four items); and (5) *utility value* (four items). From the *Learning Strategies* questionnaire, four sub-scales were selected: (1) *time-management* (four items); (2) *self-management* (four items); (3) *persistency* (four items); and (4) *help-seeking strategies* (four items), and finally, from the *Learning Skills* questionnaire, the sub-dimension of *self-assessment* (three items) was included (see the example statements of each sub-scale in Table 1).

The scales of the questionnaires comprise five-point Likert-type statements, ranging from (1) *Disagree* to (5) *Agree*. It should be noted that the *help-seeking strategies* sub-dimension also includes statements which consider help-seeking as entailing collaboration on difficult tasks. An example of this is a statement such as 'I strive to cooperate with my fellow students when doing assignments'.

Table 1. The sub-scales of the IQ Learn questionnaires with the examples of the items in each sub-scale.

Sub-scales	Example of an item for each sub-scale
Forethought of Learning	
1. Expectation of success	I am certain that I shall succeed well in my studies.
2. Self-efficacy	I can learn even the most difficult topics, if I only do my best.
3. Intrinsic interest	I get satisfaction when I have a chance to study some issues in depth.
4. Utility value	I believe that my studies will benefit me later.
5. Performance anxiety	A stressful situation significantly decreases my performance.
Strategies in Learning	
6. Time management	I stick to a certain timetable when I'm studying.
7. Self-management	I set learning goals to be able to direct my studies.
8. Persistency	I work really hard to do well in my studies even if I don't like all the tasks or the material I'm reading.
9. Help-seeking strategies	I seek help from my fellow students if I have difficulties in understanding something.
10. Self-assessment	I reflect on things thoroughly and think through what I have really learned.

The internal consistency of the sub-dimensions of the *Forethought of Learning* and the *Strategies in Learning* was examined within the current data by Cronbach's alphas, which varied between .66 and .80 (see Table 2). The confirmatory factor analysis was used in order to examine the latent factor structure of the scales based upon individual items. The sub-scales were further examined separately. The goodness of fit of the confirmatory factor structure was assessed by the following fit indices: Goodness-of-Fit Index (χ^2), Comparative Fit Index (CFI), Tucker–Lewis Fit Index (TLI), the Root Mean Square Error of Approximation (RMSEA) and the Standardised Root Mean Square Residual (SRMR) using Mplus Version 4.1 software. The *self-assessment* sub-scale consisted of only three items, so the parameter estimates were fixed and constrained so that the degree of freedom could be 1 and the model could be examined (Schumacker & Lomax, 2004, 63). The results show a relatively good fit of the factor structure to the observed data (see Table 2), except RMSEA values of sub-scales *expectations of success* (RMSEA = .113) and *persistency* (RMSEA = .091), which show poor fit of the model with higher values than the tolerable .08. However, the CFI and TLI values on these sub-scales were satisfactory.

Statistical procedures and analyses

Based on the participants' electronic mail addresses, each student's gender was coded as 1 for male, 2 for female and 0 for those whose gender could not be identified. The sample consisted of 464 (37.3%) males, 512 (41.0%) females and 271 (21.7%) respondents whose gender was not elicited. Participants' discipline was ascertained from the universities' electronic mail directories and coded as follows: 1 for economic sciences, 2 for technology and architecture, 3 for behavioural sciences, 4 for biosciences and medicine, 5 for science and 6 for the faculty of arts. In the present study, science represents Biglan's (1973) *pure hard* discipline. Technology and

Table 2. The confirmatory factor analysis and scale-wise congeneric analysis of the IQ Learn questionnaire.

Scales and sub-scales	(χ^2)	CFI	TLI	RMSEA	SRMR	α
Forethought of Learning	898.44 df = 160 p = .000	0.899	0.880	.061	0.048	
1. Expectations of success	33.78 df = 2 p = .000	0.976	0.927	.113	0.029	.76
2. Self-efficacy	21.92 df = 2 p = .000	0.979	0.937	.089	0.026	.71
3. Intrinsic interest	1.99 df = 2 p = .000	1.000	1.000	.000	0.008	.68
4. Utility value	2.37 df = 2 p = .000	1.000	0.999	.012	0.008	.75
5. Performance anxiety	5.00 df = 2 p = .082	0.996	0.987	.035	0.014	.66
Strategies in Learning	692.95 df = 142 p = .000	0.927	0.912	.056	0.052	
6. Time management	4.43 df = 2 p = .109	0.998	0.995	.031	0.009	.80
7. Self-management	5.40 df = 2 p = .067	0.995	0.985	.037	0.014	.67
8. Persistency	22.54 df = 2 p = .000	0.980	0.941	.091	0.024	.74
9. Help-seeking strategies	11.50 df = 2 p = .003	0.994	0.982	.062	0.017	.80
10. Self-assessment	2.67 df = 1 p = .102	0.997	0.992	.037	0.012	.68

Note: (χ^2) = Chi-square, CFI = Comparative Fit Index, TLI = Tucker–Lewis Fit Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardised Root Mean Square Residual, α = Cronbach's alpha.

architecture, as well as biosciences and medicine, represent *applied hard* disciplines. Arts represent the *pure soft* disciplines, and behavioural sciences *applied soft* disciplines. We also categorised economic sciences as an *applied hard* science, though it may include features of the soft sciences as well. Becher and Trowler (2001) argue that the boundaries between the hard/soft and pure/applied cannot be very precise and still several of the established disciplines fail to fit comfortably into them.

The consistency of the sum scales of the questionnaires was examined by calculating Cronbach's alpha coefficients. In addition, the confirmatory factor analysis was used in order to examine the factor structure of the scales based upon individual items. The intercorrelations among the sum scales of the questionnaires were analysed by the Pearson's correlation coefficient analysis. Analyses of variance (ANOVAs) were applied to explore the differences in the sub-scales of the *Forethought of Learning* and the *Learning Strategies*. To explore the differences between the gender groups' self-evaluation of the above-mentioned dimensions, we applied the one-way ANOVA. In order to evaluate the degree of association between the gender and sum scales, η^2 was calculated separately. The significance of the mean differences in the *Forethought of Learning* and the *Learning Strategies* between the discipline groups was also tested by one-way ANOVA. To present the effect size, η^2 was calculated separately.

To explore the mean differences between the same gender groups within different disciplines and between different gender groups within the same discipline (12 groups; one of males and one of females for each discipline), the one-way ANOVA was calculated. To study the statistical significance of the mean differences between these 12 groups, Scheffé's *post-hoc* test with its significant difference procedure (α = .05) was conducted. The statistical analysis software SPSS for Windows 15.0 was used in the analyses of this study.

Results

Relationships between sub-dimensions of SRL and gender

The first research question concerned the relationship between the components of SRL. The Pearson correlation coefficient analysis within the whole data (N = 1248) revealed a positive and a significant correlation (r from .10 to .73, p = .01) between all the components of SRL except for the sub-dimension of *performance anxiety*. *Performance anxiety* was modestly and negatively related to the other components of SRL (see Table 3).

The *expectation of success*, which indicates an optimistic attitude towards one's studies, was strongly and positively related to the feelings of *self-efficacy* and to being *intrinsically interested* and motivated in one's studies. The *expectation of success* was also positively related to judging one's studies as being profitable and worthwhile. Students who have an optimistic attitude and feel themselves to be self-efficient tend to be *intrinsically* and also *externally motivated* in their studies. On the other hand, *performance anxiety* was negatively related to the *expectation of success* and to a belief in *self-efficacy*. In other words, students who feel anxious on exams and in other performance situations do not have an optimistic attitude towards their studies and do not trust that they have the means to perform and learn effectively. *Performance anxiety* was also negatively related to *persistency* exposure. This means that students who feel anxious tend to withdraw from their studies or from performance situations.

Related to their learning strategies, the participants' *self-management* skills, *time management* and *persistency* were strongly and positively related to each other. Those who set their own learning goals, accommodate their style of studying and reflect on their actions after study attainment, also schedule their study time and try to adhere to it. In addition, these students do not give up on assignments easily, even if they confront difficulties or are not interested in all the study tasks. The students' *self-management* was also strongly and positively related to their willingness to *self-assess* and to analyse their learning to make sure they understood deeply the subject matter. However, within the sample of the present research, the above-mentioned cognitive

Table 3. The Pearson product-moment correlations between *Forethought of Learning*, *Learning Strategies* and the *self-assessment* of learning.

Sub-scales	1	2	3	4	5	6	7	8	9	10
1. Expectation of success	—									
2. Self-efficacy	.734**	—								
3. Intrinsic interest	.477**	.431**	—							
4. Utility value	.326**	.323**	.326**	—						
5. Performance anxiety	−.232**	−.285**	−.073*	−.060*	—					
6. Time management	.394**	.342**	.336**	.306**	−.078**	—				
7. Self-management	.380**	.298**	.414**	.277**	−.021	.520**	—			
8. Persistency	.483**	.423**	.446**	.319**	−.194**	.615**	.464**	—		
9. Help-seeking strategies	.095**	.062*	.136**	.218**	.000	.123**	.246**	.146**	—	
10. Self-assessment	.418**	.360**	.509**	.177**	−054	.339**	.513**	.398**	.188**	—

Note: *Correlation is significant at .05 level (two-tailed); **Correlation is significant at .01 level (two-tailed).

strategies in learning related positively but weakly to the students' willingness to *seek help* from fellow students, for example, to discuss difficult tasks or their experiences related to learning.

The students' *intrinsic interest* was strongly and positively related to their willingness to *self-assess* their learning. Students who value learning in itself tend to analyse their learning through reflection and make sure that they understand deeply what they study. Intrinsic interest was also positively but only somewhat strongly related to *persistency*, *self-management* and *time management*. Instead, students who are highly *intrinsically interested* in their studies are not necessarily dependent on their peers' help even if the students encounter difficulties in their learning. In addition, the students' *persistency* was positively related on a moderate level to their *expectation of success* and *self-efficacy*. In other words, students who continue studying even though they encounter difficulties in understanding or lose motivation, are quite sure they will succeed well and are able to learn even the most difficult topics if they do their best.

The interrelations of gender with the components of self-regulation in learning

Our second research question was how the self-regulation in learning differs between the female and male students in higher education. The differences between the gender groups' means were minor on almost all dimensions of *Forethought of Learning* and *Strategies in Learning* (see Table 4), but the female students scored slightly higher than the male students on all dimensions, except for *self-efficacy*. The scores of the students whose gender was not elicited varied between the scores of the female and the male students. Measured by one-way ANOVA, statistically significant mean differences between the gender groups were found on the sub-dimensions of *help-seeking strategies* ($F[2, 1245] = 19.38$, $p = .000$), *utility value* ($F[2, 1245] = 6.60$, $p = .001$) and *performance anxiety* ($F[2, 1245] = 6.29$, $p = .002$). Furthermore, an effect size index η^2 was calculated separately. The values of η^2 show that the gender explained 3% or less of the differences in the students' results on the sub-dimension of the questionnaires.

The interrelations of discipline with the Forethought of Learning

The third research question in our investigation concerned the characteristics of SRL within the diverse disciplines and the differences of SRL between the students representing the various disciplines. The significances of the mean differences of the discipline groups were tested by one-way ANOVA. The results concerning the *Forethought of Learning* are presented first and then the results of the *Strategies of Learning*. The differences were significant (see Table 5) on all sub-dimensions of the *Forethought of Learning*. Table 5 presents the results in order from the *pure hard* disciplines to *pure soft* disciplines. The greatest difference between the means of the discipline groups was on the sub-dimension of *intrinsic interest*. Here the students of behavioural sciences and biosciences and medicine scored highest, and the students of technology and science, lowest. On the sub-dimensions of *expectations of success* and *utility value*, the technology and biosciences and medicine students scored somewhat lower than the students of behavioural sciences and economics. The mean differences were slighter on the sub-dimension *utility value.* Moreover, *performance anxiety* was highest among the science and arts students and lowest among the

Table 4. Summary statistics for the one-way ANOVAs performed on the sub-dimensions of the self-assessment tests by gender groups.

Sub-scales	Gender	*M*	SD	*F*	*p*	η^2
Expectations of success	Female (n = 511)	3.62	.62	.247	.781	.000
	Male (n = 464)	3.59	.66			
	Unknown (n = 273)	3.59	.71			
Self-efficacy	Female	4.04	.56	.422	.656	.001
	Male	4.07	.58			
	Unknown	4.07	.63			
Intrinsic interest	Female	3.93	.63	4.424	.012	.007
	Male	3.85	.61			
	Unknown	3.80	.65			
Utility value	Female	4.56	.51	6.598	.001	.010
	Male	4.43	.60			
	Unknown	4.48	.57			
Performance anxiety	Female	2.76	.76	6.291	.002	.010
	Male	2.58	.74			
	Unknown	2.66	.77			
Time management	Female	3.12	.85	.633	.531	.001
	Male	3.10	.82			
	Unknown	3.05	.82			
Self-management	Female	3.41	.71	2.926	.054	.005
	Male	3.31	.71			
	Unknown	3.41	.72			
Persistency	Female	3.48	.74	3.514	.030	.006
	Male	3.36	.75			
	Unknown	3.38	.80			
Help-seeking strategies	Female	3.60	.82	19.382	.000	.030
	Male	3.29	.90			
	Unknown	3.29	.88			
Self-assessment	Female	3.14	.85	1.637	.195	.003
	Male	3.05	.77			
	Unknown	3.05	.78			

technology and economics students, but these differences were minor. The mean scores on *self-efficacy* did not differ much between the discipline groups. Accordingly, in our data, the students of *applied soft* and *hard* sciences scored higher than the students of *pure soft* and *hard* on the sub-dimensions of *intrinsic interest*, *utility value* and *self-efficacy*. Instead, the students of the pure sciences self-assessed their *performance anxiety* to be higher than the students of the applied sciences. η^2 revealed that the associations are minor between these disciplines and the sub-scales of the *Forethought of Learning*. More specifically, the discipline explained only 2–5% of the differences in the students' results on the sub-scales of the *Forethought of Learning*.

In the next phase, to answer our fourth research question, the differences in the means between the gender groups within each discipline were tested using the

Table 5. Summary statistics for the one-way ANOVAs performed on the sub-dimensions of *Forethought of Learning* by discipline groups.

Sub-scales	Discipline	*M*	SD	*F*	*p*	η^2
Expectations of success	Science (*n* = 113)	3.63	.60	12.383	.000	.032
	Technology (*n* = 376)	3.42	.69			
	Biosciences and medicine (*n* = 114)	3.47	.64			
	Economics (*n* = 425)	3.73	.63			
	Behavioural sciences (*n* = 153)	3.78	.55			
	Arts (*n* = 66)	3.56	.72			
Self-efficacy	Science	4.03	.53	9.048	.000	.028
	Technology	3.96	.60			
	Biosciences and medicine	3.90	.63			
	Economics	4.18	.54			
	Behavioural sciences	4.14	.52			
	Arts	3.92	.72			
Intrinsic interest	Science	3.68	.62	15.917	.000	.054
	Technology	3.86	.60			
	Biosciences and medicine	4.10	.64			
	Economics	3.86	.60			
	Behavioural sciences	4.14	.60			
	Arts	3.88	.70			
Utility value	Science	4.48	.56	11.373	.000	.022
	Technology	4.38	.62			
	Biosciences and medicine	4.39	.51			
	Economics	4.62	.46			
	Behavioural sciences	4.60	.53			
	Arts	4.50	.70			
Performance anxiety	Science	3.00	.76	8.663	.000	.025
	Technology	2.57	.74			
	Biosciences and medicine	2.80	.77			
	Economics	2.60	.71			
	Behavioural sciences	2.71	.77			
	Arts	2.91	.90			

one-way ANOVA procedure. Scheffé's *post-hoc* test with its significant difference procedure (α = .05) was conducted to study the statistical significance of the mean differences in the *Forethought of Learning*. When the discipline was controlled, the only significant difference between the gender groups' means was that the female students of economics self-evaluated their *performance anxiety* to be higher than their male peers (a mean difference of .384, significance Scheffé test α = .032, *d* = .57 [medium]).

The one-way ANOVA, with Scheffé's *post-hoc* tests (α = .05), showed several mean differences between the same gender groups across the disciplines on several sub-dimensions of the *Forethought of Learning*. Firstly, among female students, the differences between discipline groups were found in their *expectations of success* (F[5, 505] = 4.06, p = .001), *intrinsic interest* (F[5, 505] = 7.60, p = .000), *utility value*

(*F*[5, 505] = 4.41, *p* = .001) and *self-efficacy* (*F*[5, 505] = 4.02, *p* = .001). The pairwise comparisons using Sheffé's *post-hoc* test with its significant difference procedure (α = .05) revealed several statistically significant differences between the discipline groups of the female students. The students of behavioural sciences had higher *expectations of success* (*p* = .004) and *self-efficacy beliefs* (*p* = .021) than the female students of biosciences and medicine. In addition, the female students studying economics had higher *self-efficacy beliefs* (*p* = .015) than the biosciences and medicine female students. Moreover, the female students of behavioural sciences indicated a higher (*p* = .000) *intrinsic interest* than the technology students and the female students of economics (*p* = .001). Furthermore, whereas the female biosciences and medicine students had a higher (*p* = .030) *intrinsic interest* than the female technology students, the female economics students had a higher (*p* = .019) *utility value* than their counterparts in biosciences and medicine. However, significant differences on *performance anxiety* were not found among the female students. For the profiles of the female students' scores on the *Forethought of Learning*, see Figure 1. Note that the scale of *self-assessment* questionnaires varied between 1 and 5, but in the following figures, the scale begins from 2.

Next, among male students, the *F*-test revealed mean differences between discipline groups in the *expectations of success* (*F*[5, 458] = 8.07, *p* = .000), *intrinsic interest* (*F*[5, 458] = 7.48, *p* = .000), *self-efficacy* (*F*[5, 458] = 8.24, *p* = .000) and *performance anxiety* (*F*[5, 458] = 8.68, *p* = .000). Scheffé's *post-hoc* test (α = .05) showed some statistically significant differences between the male student groups in the different disciplines. On the sub-dimension called the *expectations of success*, the technology students scored significantly lower than the students of economics (*p* = .000) and the students of behavioural sciences (*p* = .032). As for the *intrinsic*

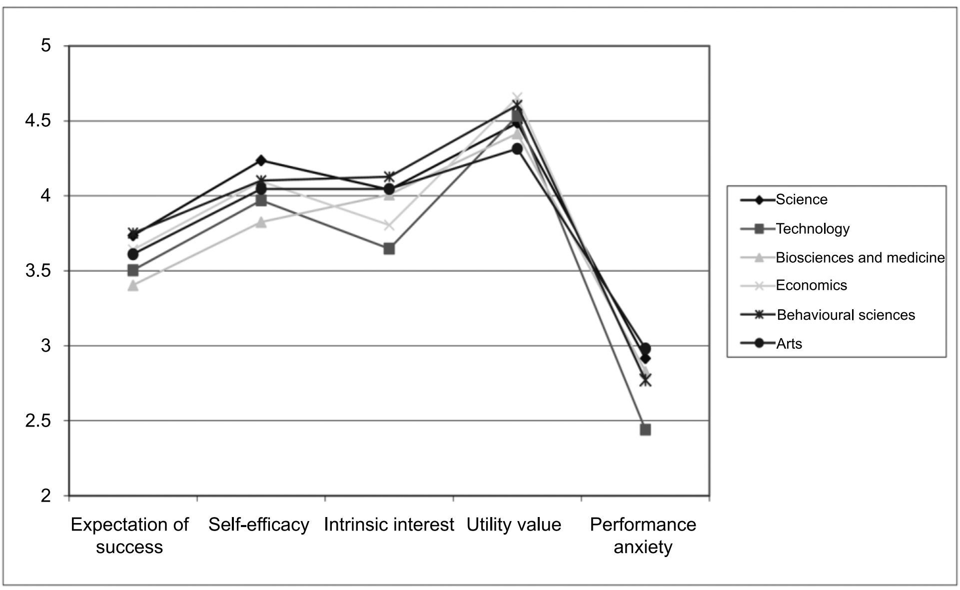

Figure 1. Mean results of the female students in different disciplines on the *Forethought of Learning*. Note: The vertical axis represents the mean scores and the horizontal axis represents sub-dimensions of the test.

interest, the technology students scored significantly lower on this than the students of biosciences and medicine (p = .005), behavioural sciences (p = .009) and economics (p = .019). The students of behavioural sciences scored significantly higher on *self-efficacy* than the students of technology (p = .019) and science (p = .019). Furthermore, the students of economics had significantly higher *self-efficacy* than the students of technology (p = .000) and science (p = .002). Another finding was that the *performance anxiety* was significantly higher among the students of science than male students of economics (p = .000), technology (p = .002) and behavioural sciences (p = .004).

Figure 2 also shows that on the *Forethought of Learning*, the male technology students scored lowest or almost lowest on almost all sub-dimensions of the questionnaire. On the contrary, the behavioural sciences male students scored highest on all sub-dimensions, except they scored lowest on *performance anxiety.*

The interrelations of the discipline with Strategies in Learning

The differences in the disciplines and the characteristics of the SRL in the diverse disciplines in learning strategies were examined next. The mean differences between the discipline groups on the sub-scales of the *Strategies in Learning* were statistically significant (p < .0005). On the sub-dimension *time management* (see Table 6), the behavioural sciences students scored highest and the biosciences and medicine students lowest, but the mean differences were minor. On *self-management*, the differences were slightly similar, though the mean scores of the technology and biosciences and medicine students were somewhat lower than those of the other discipline groups. On the *persistency* and *help-seeking strategies*, the technology students scored lowest

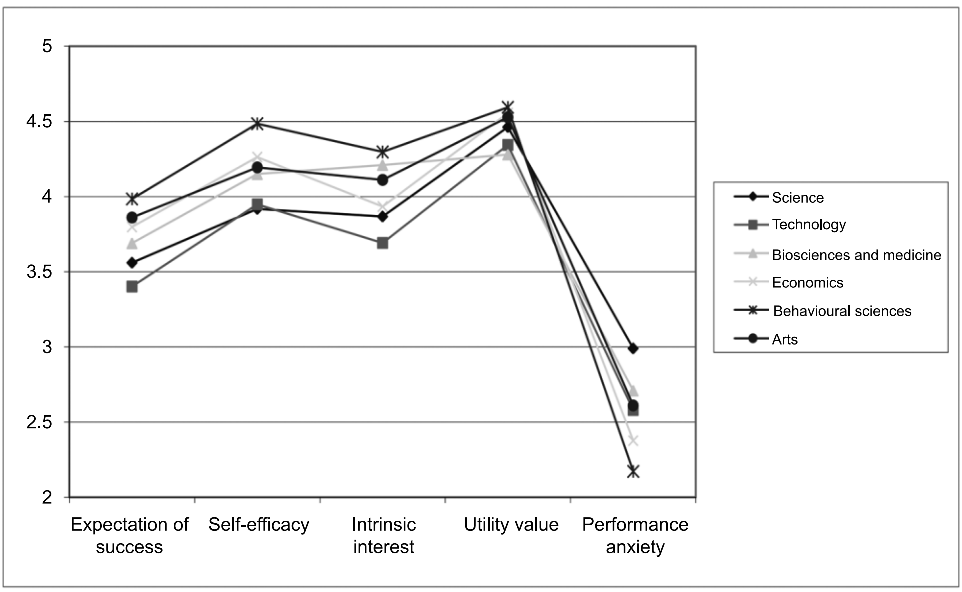

Figure 2. Mean results of the male students in different disciplines on the *Forethought of Learning*. Note: The vertical axis represents the mean scores and the horizontal axis represents sub-dimensions of the test.

and the behavioural sciences students highest. Finally, on *self-assessment,* the students of behavioural sciences and the students of arts scored highest and the students of technology scored lowest. Considering the differences between the *pure* and *applied soft* and *hard* sciences, it is evident that the students of the *applied hard* sciences scored lowest on *time management* and *self-management*, and the students of the *soft* sciences scored highest on *self-assessment.* Partial η^2 revealed that the associations between the disciplines and the sub-scales of the *Strategies in Learning* are minor. More precisely, the discipline explained only 1–4% of the differences of the students' results on the sub-scales of *Strategies in Learning*.

To answer our fourth research question concerning *Learning Strategies*, the one-way ANOVA and Scheffé's *post-hoc* test with its significant difference procedure (α = .05) were performed to study the significance of the mean differences in the *Learning*

Table 6. Summary statistics for the one-way ANOVAs performed on the sub-dimensions of *Strategies in Learning* by discipline groups.

Sub-scales	Discipline	*M*	SD	*F*	*p*	η^2
Time management	Science (n = 113)	3.10	.86	9.453	.000	.034
	Technology (n = 376)	2.93	.81			
	Biosciences and medicine (n = 114)	2.89	.79			
	Economics (n = 425)	3.23	.82			
	Behavioural sciences (n = 153)	3.32	.83			
	Arts (n = 66)	2.97	.78			
Self-management	Science	3.50	.65	7.522	.000	.020
	Technology	3.22	.70`			
	Biosciences and medicine	3.29	.67			
	Economics	3.44	.71			
	Behavioural sciences	3.55	.75			
	Arts	3.40	.75			
Persistency	Science	3.42	.76	12.117	.000	.040
	Technology	3.20	.74			
	Biosciences and medicine	3.31	.69			
	Economics	3.55	.76			
	Behavioural sciences	3.63	.68			
	Arts	3.40	.76			
Help-seeking strategies	Science	3.52	.87	5.052	.000	.011
	Technology	3.25	.92			
	Biosciences and medicine	3.39	.90			
	Economics	3.48	.84			
	Behavioural sciences	3.60	.82			
	Arts	3.34	.77			
Self-assessment	Science	3.17	.78	11.208	.000	.043
	Technology	2.88	.75			
	Biosciences and medicine	3.04	.81			
	Economics	3.12	.80			
	Behavioural sciences	3.39	.79			
	Arts	3.31	.85			

Strategies between the gender groups within each discipline. Among female students, the *F*-test revealed the differences between the disciplines on sub-dimensions were referred to as *time management* ($F[5, 505] = 3.55$, $p = .004$), *persistency* ($F[5, 505] = 3.66$, $p = .005$) and *self-assessment* ($F[5, 505] = 7.55$, $p = .000$). Pairwise comparisons using Scheffé's *post-hoc* test ($\alpha = .05$) showed that the female students of behavioural sciences scored significantly higher on *time management* than the female students of biosciences and medicine ($p = .046$) (see Figure 3). The behavioural sciences students self-evaluated their *persistency* ($p = .028$) and *self-assessment* ($p = .002$) to be higher than the female technology students. In addition, the students of arts ($p = .006$) and science ($p = .041$) scored higher on the *self-assessment* than the students of technology. Compared to all disciplines, the students of arts and those of science reported using *self-assessment* most often. It seems that the female students of the *applied hard* sciences do not use *self-assessment* as much as those who are in the *soft* sciences and in *pure hard* science.

Among male students, the *F*-test revealed differences between the different disciplines on all sub-dimensions of the *Learning Strategies*: *time management* ($F[5, 458] = 6.46$, $p = .000$), *self management* ($F[5, 458] = 4.66$, $p = .000$), *persistency* ($F[5, 458] = 7.32$, $p = .000$), *help seeking* ($F[5, 458] = 3.71$, $p = .003$) and *self-assessment* ($F[5, 458] = 6.77$, $p = .000$). In addition, the *post-hoc* comparisons (Scheffé test, $\alpha = .05$) showed that the male students of economics scored significantly higher than students of technology ($p = .000$) and the students of biosciences and medicine ($p = .020$) on *time management* (see Figure 4). Furthermore, the economics students scored significantly higher on *self-management* ($p = .007$), *persistency* ($p = .000$), *help-seeking strategies* ($p = .017$) and *self-assessment* ($p = .001$) than their peers in technology. In addition, the behavioural sciences students' self-evaluations were significantly higher ($p = .009$) on their *self-assessments* than those of the male students of technology.

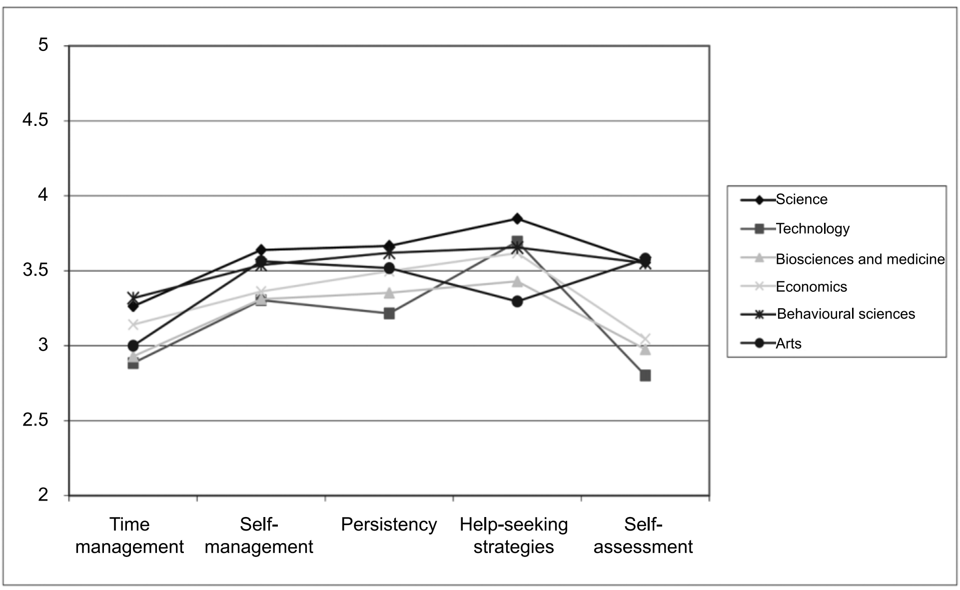

Figure 3. Mean results of the female students in different disciplines on the *Strategies in Learning*. Note: The vertical axis represents the mean scores and the horizontal axis represents sub-dimensions of the test.

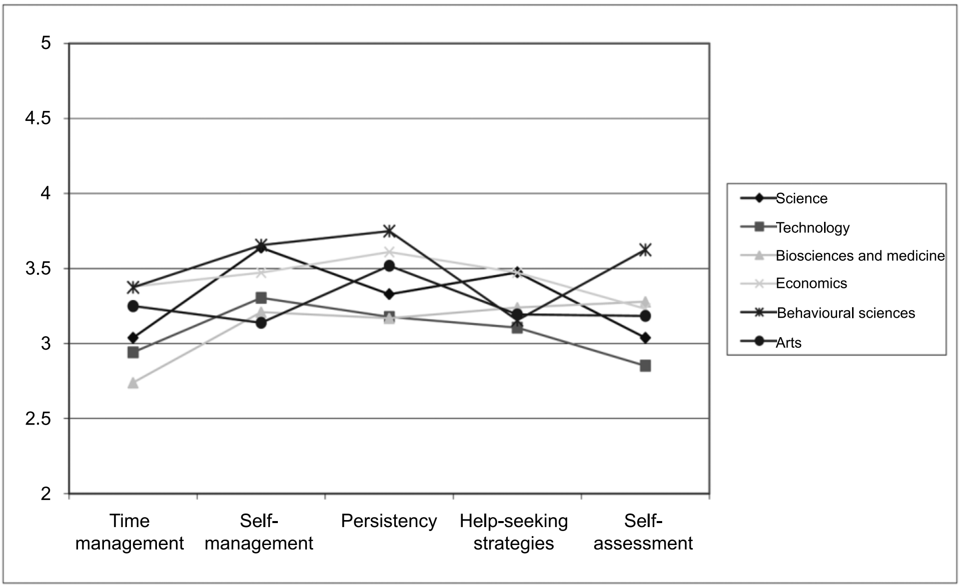

Figure 4. Mean results of the male students in different disciplines on the *Strategies in Learning*. Note: The vertical axis represents the mean scores and the horizontal axis represents sub-dimensions of the test.

Discussion

In the present study, we explored the higher education students' self-regulation in learning and how this differs for female and male students representing the different academic disciplines using *self-assessment*. During the first phase, we examined the correlations between the sub-scales of SRL, and all, except for *performance anxiety*, correlated positively with each other at a .01 level. We expected that the components of SRL would be positively related to each other. Hativa and Birenbaum (2000) found that a high intrinsic goal orientation predicted a preference for the self-regulation promoting instruction. In the present data, a stronger positive correlation was found between the *intrinsic interest* and the other sub-scales of self-regulation in learning than between the *utility value* and other sub-dimensions. Moreover, *intrinsic interest* correlated in our data especially strongly with *self-assessment, persistency, self-management* and *time management,* which are important elements in SRL. However, the correlations between the *utility value* and the above-mentioned sub-scales were weaker but positive, which is contrary to the finding of Hativa and Birenbaum (2000) that students with low extrinsic goal orientation preferred instruction promoting self-regulation. According to our data, both intrinsic and extrinsic interests are positively related to using self-regulation in learning, but the intrinsic interest seems to play a more important role.

Our second research question concerned the gender differences in self-regulation in learning. Our main finding was that the mean results of the female students as compared to the male students were in general slightly higher in the sub-dimensions of SRL, both in the *Forethought of Learning* and in the *Strategies in Learning*. As we expected, the female students scored slightly lower than the male students on *self-efficacy*. In contrast, as was presumed, the female students scored statistically significantly higher on the *help-seeking strategies*, *utility value* and *performance anxiety*. Likewise, Bembenutty (2007, 2009a) found a stronger connection between the female students' task value than the male students' task value and in their willingness for ADOG, which is a phenomenon closely related to SRL. Niemi et al. (2003) discovered significantly higher *intrinsic interest* among female students. Furthermore, in the current data, the female students also scored higher on that dimension but the difference was not statistically significant. In general, our findings are in line with Pintrich and Zusho's (2007) review that gender differences in the self-regulation of learning are minor or inconclusive.

Our third research question was concerning the investigation of the disciplinary differences in SRL. We found statistically significant (p < .0005) differences in the means within the disciplines: science, technology, biosciences and medicine, economics, behavioural sciences and arts, in all the sub-dimensions of SRL. However, the discipline itself did not explain much of the variance. In other words, the general level of SRL is not dependent on the student's discipline. Whereas few studies are available on the disciplinary differences in SRL, the results of our study are partially congruent with the results of Niemi et al. (2003). In both studies, the students of behavioural sciences and arts evaluated their *performance anxiety* as being high. In the current study, the science students evaluated themselves to be the most anxious and the technology students the least anxious, but in the Niemi et al. (2003) study, the students in the *hard* disciplines from technology and science scored low on *performance anxiety*. Congruity was found with Niemi et al.'s (2003) study in the students' *self-assessment*, which included significant mean differences. In both the studies, the students of behavioural sciences and arts scored highest. In addition, the previous study (Niemi et al., 2003) reported that the students of teacher education scored even slightly higher than the students of other disciplines. The technology students scored lowest in the current study and the technology and science students in Niemi et al.'s (2003) study also scored lowest.

Hativa and Birenbaum (2000) demonstrated that the education students prefer a teaching style which promotes self-regulation more than the engineering students. They argue that the engineering students are required to use SRL more than the education students, because the engineering students are required to conduct original and inventive individual projects. Hativa and Birenbaum conclude that all students favour an instructional approach of which they have little experience, whereas the teaching approach they mainly experience is not as appreciated. According to our data, on the contrary, the behavioural sciences students reported using SRL the most and the technology students used SRL the least. Apparently further research is needed on the congruity in the students' learning approaches and instructional approaches.

We found a few systematic differences between the *pure* and *applied soft* and *hard* sciences. Students of the applied sciences scored higher than the students of the pure sciences on *intrinsic interest, utility value* and *self-efficacy*, and the students of the pure sciences also self-assessed their *performance anxiety* to be higher than those of the applied sciences. Based on previous research, we expected that students of the *soft* sciences would have scored higher on *performance anxiety*. In comparison, students of the *applied soft* sciences, the behavioural sciences to be exact, scored highest on the *expectation of success* and *intrinsic interest* on the *Forethought of Learning* as well as on all the sub-scales of the *Strategies in Learning*.

Meanwhile, the students of the *applied hard* sciences scored lowest on *time management* and *self-management*. Finally, the students of the *soft* sciences scored higher on their *self-assessment*, as we expected. These mean differences may be due to the differences in instructional methods and due to the focus of student learning in disciplines. An additional factor is that a student's level of knowledge on factors affecting learning is probably different, for example, for the educational sciences students and the science students.

Finally, the present research examines whether or not interdisciplinary differences vary between the genders. Within the same discipline groups, only two statistically significant differences were found. The female students of economics reported higher *performance anxiety* than their male peers, and the female technology students scored higher on the *help-seeking strategies* and collaboration than their male counterparts in technology. Within the same gender group across disciplines, several statistically significant differences were found, though the mean differences were minor. The science and behavioural sciences female students scored highest on the various sub-dimensions of the *Forethought of Learning*. The technology and biosciences and medicine female students scored slightly lower on several sub-dimensions. On *Learning Strategies*, again the female students of science and those of behavioural sciences scored highest and the technology female students scored lowest, except that the technology female students scored above the mean level on the *help-seeking strategies*. Among male students, the behavioural sciences students reported their best results on all the sub-dimensions of the *Forethought of Learning*. The technology male students had the weakest results, except in the category of *performance anxiety*, in which they scored at the mean level. On *Learning Strategies*, the behavioural sciences male students scored highest again, except on the *help-seeking strategies*, which were lower than the mean level. Scoring lowest on the *Learning Strategies* varied mainly between the technology and biosciences and medicine male students. The participants who most often scored highest were the female students of science and behavioural sciences and the male students of behavioural sciences. On the contrary, participants who most often scored lowest were the female and male technology students.

The behavioural sciences students may be most experienced on self-evaluation which is related to their learning and performance as compared to the students in other disciplines, and that may explain the trend. However, the question remains as to why the technology male students scored clearly low. Could this be due to technology traditionally being a discipline for men and some young males consequently choosing that discipline without critically thinking about which discipline they honestly would be most interested in to study? Another possibility is that some males do not dare to choose a traditionally female discipline. Moreover, we propose that male students in the behavioural sciences, which has traditionally been a female discipline, might have been more certain as to their true interests and thus feel more motivated to study and to use diverse learning strategies and also to be sure of their success.

There are some methodological limitations to the present study. First, the data were collected by a self-report instrument. Vermetten, Vermunt, and Lodewijks (1999) bring out the disadvantage of the self-report method, as it does not assess the actual behaviour but focuses on the participants' ideas about their behaviour. In addition, the instrument we used was not context specific, which is contrary to Pintrich's (2004) recommendation to use instruments adapted at the course level. The instrument used in the present study focused on university learning in general.

The same self-evaluation questionnaires were used in another study where students were also interviewed on themes corresponding to those the self-evaluation questionnaires measure. In this study (Virtanen & Nevgi, in preparation), the results of the self-evaluation paralleled the results of the interview analysis. Secondly, the number of students in each discipline group varied from 66 to 425 students. This affected the statistical analyses, for instance, by diminishing the number of the significant mean differences between the discipline groups. However, the systematic nature of the interdisciplinary differences favours our conclusions.

Future research and implications

Without a doubt, additional research is needed on gender and the disciplinary differences in the self-regulation of learning. Future research needs to focus on a larger database and on an equal number of participants in different disciplines and of different genders. Based on the results and conclusions of our study, we conclude that more research is necessary on SRL among those students studying in the disciplines traditionally considered to be typical and atypical to their gender. More research is also needed in the future on the relations between the students' SRL and the instructional approach adopted, as well as on the connection between self-regulation skills and the students' academic achievement in the different disciplines. Possible future research topics might also be to study the relation of success to SRL and to the high level of *performance anxiety* of female students.

Based on our findings, we suggest that more attention should be paid to students' learning strategies and motivation in all disciplines, but especially to those in technology and biosciences and medicine where students scored lowest on several sub-dimensions of SRL. Though our research data were collected by administering self-assessment questionnaires and some of the differences might be due to response bias, the curriculum planners could introduce a study skills course based on modern learning psychology to the degree programmes in those disciplines that do not include courses on learning. As intrinsic interest correlated strongly with the core elements of SRL within our data, we suggest that in order to minimise the number of unmotivated students in higher education, more student advising needs to be offered. If the students were sure they had selected the right discipline – even a discipline not typical for their gender – they perhaps would be more motivated in their studies and find it meaningful to devote time to using learning strategies leading to deep learning.

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